Original Article

Overcoming Barriers to Mammography Screening: A Quasi-randomised Pragmatic Trial in a Community-based Primary Care Setting

Theresa Seetoh, [1]*BSocSci (Hons), MSc*, Wei Fong Siew, [2]*MBBS, MMed FM, DIP (Family Practice Dermatology)*, Alvin Koh, [3]*MBBS, MPH*, Wei Fong Liau, [2]*RN, BN, MN*, Gerald CH Koh, [1]*MBBS, MMed FM, PhD*, Jeannette JM Lee, [1]*MBBS, MD*, Mee Lian Wong, [1]*MBBS, MPH, MD*, Adeline Seow, [1] *MBBS,MMed (Public Health), MD*

Abstract

Introduction: Breast cancer is the leading cancer among women in Singapore. Five years after a population-wide breast cancer screening programme was introduced, screening rates remained relatively low at 41%. Studies have shown decreased screening propensity among medically underserved women typically of minority or socioeconomically disadvantaged status. We conducted a quasi-randomised pragmatic trial aimed at encouraging mammography screening among underscreened or unscreened women in a publicly funded primary care facility in Singapore. Materials and Methods: The study was conducted from May to August 2010. Components of intervention included (1) tailored education, (2) doctor's reminder, and (3) cost reduction. Researchers administered a structured questionnaire to eligible female polyclinic attendees and patient companions aged 40 to 69 years. Individual knowledge, attitudes, beliefs, and barriers towards mammography screening were identified and educational messages tailored. Doctor's reminder and cost reduction were implemented additively. Results: Overall, out of 448 participants, 87 (19.4%, 95% confidence interval (CI), 15.8% to 23.1%) completed mammography screening across 3 arms of study. Participants who received a cost reduction were more likely to attend screening compared to participants in other intervention arms (adjusted odds ratio (OR) 2.4, 95% CI, 1.2 to 4.5, *P* = 0.009). Cost of screening, ethnicity, prior screening history, and attitudes towards mammography screening were identified as significant factors predicting mammogram attendance. Conclusion: Including a cost reduction component was the most effective intervention that increased mammography screening rates. Women's underlying beliefs, attitudes, and other predisposing factors should also be considered for integration into existing breast cancer screening programmes.

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Introduction

Breast cancer is the leading cancer among women in Singapore, accounting for 29% of all cancers occurring in women between 2006 and 2010.[1] Evidence shows that breast cancer screening with mammography is effective at reducing breast cancer mortality, particularly where the uptake of screening is high, at a recommended 70%,[2,3] with good quality control.[4]

The first large-scale study of the use of mammography in Asian women was the Singapore Breast Screening Project,[5] conducted in 1994. The study demonstrated the usefulness of a population-level screening programme in the detection and treatment of early-stage breast cancer. This was followed by the launch of a nationwide, population-based breast cancer screening programme, BreastScreen Singapore, in 2002. The programme offered mammography screening at a government-subsidised rate, and was open to Singapore female residents and permanent residents, aged 40 to 69 years. Through a series of public awareness campaigns, mammography screening was widely promoted as an accepted modality for early detection of breast cancer.

Five years after the programme was introduced, the estimated rate of women who participate in mammography screening at recommended intervals remained relatively

[1]Saw Swee Hock School of Public Health, National University of Singapore, Singapore
[2]National Healthcare Group Polyclinics, Singapore
[3]Primary Care Development Division, Agency for Integrated Care, Singapore
Address for Correspondence: A/Prof Adeline Seow, Saw Swee Hock School of Public Health, National University of Singapore, MD3, 16 Medical Drive Singapore 117597.
Email: adeline_seow@nus.edu.sg

low at 41%.[6] Five-year mortality for breast cancer in Singapore is also relatively poor, at an observed survival rate of 64%.[7] In countries such as the United States, patient navigation has been shown to improve the accessibility of breast cancer screening programmes, particularly for underserved populations, by helping women identify barriers to timely diagnosis as well as guide them through the completion of a healthcare service.[8-13] Other measures such as health education,[14] reminders,[15,16] responding in a culturally-sensitive manner[17] and setting up collaboration between academic and medical centres,[11] have also reported improved screening uptake.

Our goal was to test if a practical and sustainable intervention could be introduced and integrated at the primary care level to overcome barriers and improve screening rates in Singapore. The suite of interventions included (1) tailored education delivered by a patient navigator, (2) doctor's reminder, and (3) cost reduction.

Materials and Methods

The pilot study was designed as a quasi-randomised pragmatic trial conducted in a public service primary care facility (Clementi Polyclinic) in Singapore from May to August 2010. Enrolment was by successive presentation at the polyclinic. A formal protocol was established with structured training provided to interviewers fluent in English, Mandarin, and Malay, who simulated the role of a patient navigator. A circular was also disseminated to inform doctors of the pilot study. This provided a structure within which communication by patient navigators and doctors could be adapted to individual patient's needs. Ethical approval was obtained prior to the commencement of the study.

The study was conducted over 2 consecutive weeks, comprising 3 intervention phases: a baseline of tailored education over a period of 2 days, a doctor's reminder, and cost reduction added progressively over 2 periods of 4 days each. A structured questionnaire was administered to female attendees between the ages of 40 to 69 years and their companions to identify individual knowledge, attitudes, beliefs, and barriers towards mammography screening (Table 1). Respondents due and eligible for mammography screening under BreastScreen Singapore were recruited as study participants and written informed consent was obtained. In the first intervention of the study, patient navigators delivered tailored education messages based on individually-expressed concerns and misconceptions on mammography screening, gleaned from study participants' responses on the questionnaire and communicated in a language they can comfortably understand. During the second intervention of the study, doctors reinforced the rationale and importance of early detection through mammography screening, in addition to participants receiving the tailored education message. A supplemental cost reduction measure in the form of a discount voucher was introduced as the third intervention.

Table 1. Components of the Scales Used to Measure Knowledge, Attitudes, Beliefs and Barriers among Study Population in a Primary Care Facility in Singapore (May to August 2010)

Factor	Question or Statement Posed*
Knowledge	• Do you know that you can have a mammogram done at Clementi Polyclinic? (Yes/No) • I know at what age I should start going for a mammogram. • I know how regularly I should go for a mammogram.
Attitudes	• I am fearful of the potential pain involved in mammogram screening. • I would rather not know if I have breast cancer.
Beliefs	• Mammograms are safe for the early detection of breast cancer. • Mammograms are effective for early detection of breast cancer. • I am at risk of getting breast cancer as my age increases. • I do not need a mammogram if I do not display any breast symptoms (such as lumps, nipple discharge, and/or pain). • A mammogram is not necessary for a woman with no family history of breast cancer.
Barriers	• A mammogram is too costly for me. • I can find time for a mammogram if I wish to go for one.

*Except for the first question, all responses were on the 5-point Likert scale (strongly agree, agree, unsure, disagree, strongly disagree)

Upon presentation of the discount voucher valid only at the mammogram facility sited on the premises of the same primary care clinic, participants were eligible for a mammography screening discount of S$25. This was equivalent to a 50% reduction of the cost of a mammogram for Singapore citizens and a 33% reduction for permanent residents. To prevent unauthorised duplication or transfer of the voucher, each voucher bore an individualised serial number and was linked to the identification number of the participant carrying the voucher. The outcome measured was the number of participants who completed mammograms in the 12 weeks following the study. Mammography screening records belonging to the mammography facility were checked to identify participants who had successfully completed a mammogram by referencing their identification number, and this was verified via an anonymised matching link with BreastScreen Singapore.

Sample Size Calculations

Based on results of a pre-pilot study (unpublished data), we estimated that the baseline uptake of mammography would

be 8% in the study population. To detect a 2-fold increase in attendance to 16% in each of the other 2 intervention phases, a sample size of about 147 would be required in each intervention arm to achieve 80% power at a 5% level of significance (2-sided).

Data Analysis

Analysis was done on an intention-to-treat basis to evaluate the effectiveness of the suite of interventions under practical experience. The data was analysed using SPSS (version 17, IBM Corporation) software. The main exposure of interest was the intervention rendered, and the primary outcome was completion of a mammography screening within 12 weeks of intervention. Demographic and other predictors of screening were also analysed in relation to primary outcome.

To ensure comparability between intervention arms, the distribution of baseline characteristics were compared and differences were tested using Pearson chi-square test. Components of the health belief model used to measure knowledge, attitudes, beliefs and barriers were scored using the 5-point Likert scale, with 0 score for "unsure", and positive and negative scoring on either side of the scale depending on the question asked. For instance, for the question, "A mammogram is too costly for me", a respondent who answered "strongly agree" was accorded negative 2 score, "agree" was accorded negative 1 score, "unsure" was accorded 0 score, while "disagree" and "strongly disagree" were respectively accorded 1 and 2 score. The decision to categorise each component into high/low subgroups was made using the mean score within each factor as cut-off point.

Mantel-Haenszel crude odds ratio (OR) was obtained for each binary variable against outcome, while logistic regression was performed for ordinal variables against outcome to give stratum-specific crude OR. Potential confounders were explored by cross-tabulating other exposure variables against the main exposure of interest as well as cross-tabulating against outcome. Variables resulting in a considerable change of 10% of the adjusted OR compared to the crude OR were considered confounders and were included in the final model. Multivariable analysis was performed using logistic regression to obtain an adjusted measure of effect, with results at $P < 0.05$ taken as significant. Effect of intervention on screening uptake was stratified by sociodemographic characteristics to test for effect modification.

Results

The team approached a total of 788 women over the study period. Two-thirds (523 or 66.4%) were due for screening while a third (257 or 32.6%) had been screened within the last 2 years. Of those due for screening, 448 (85.7%) consented to the study and were recruited as participants. The remaining declined study participation. Overall, 87 (19.4%, 95% CI, 15.8% to 23.1%) out of 448 participants completed mammography screening across 3 arms of the study. Attendance varied significantly with intervention received.

Majority (180 or 40.2%) of the 448 women recruited were in the 50 to 59 age group, while 125 (27.9%) and 143 (31.9%) women were in the 40 to 49 and 60 to 69 age groups respectively (Table 2). The Chinese (301 or 67.2%) was the majority ethnic group, followed by the Malays (105 or 23.4%) and the Indians/Others (42 or 9.4%). Most women (221 or 49.3%) stayed in public housing with 4 to 5 rooms, consistent with the residential distribution served by the polyclinic. More than half (259 or 57.8%) received at least a secondary education or above and 181 (40.5%) were in employment. The remaining were either unemployed (216 or 48.3%) or retired (50 or 11.2%). The group which received the tailored education-doctor's reminder-cost reduction intervention had a higher proportion of Chinese ($P = 0.005$) and women who were more well educated ($P = 0.021$) and lived in private residence ($P = 0.026$). Other baseline characteristics did not differ across intervention groups.

Mammogram attendance across 3 intervention arms at completion of study was 15.1% (95% CI, 8.3% to 21.9%) from the tailored education arm, 9.9% (95% CI, 6.0% to 15.3%) from the tailored education-doctor's reminder arm, and 32.9% (95% CI, 25.7% to 40.2%) from the tailored education-doctor's reminder-cost reduction arm (Fig. 1). Adjusted analysis of the association between the type of intervention received and screening uptake showed that study participants from the tailored education-doctor's reminder-cost reduction arm were 2.4 (95% CI, 1.2 to 4.5, $P = 0.009$) times more likely to complete a mammography screening compared to participants from the tailored education arm, whereas those from the tailored education-doctor's reminder arm were not more likely to complete a screening compared to those from the tailored education arm (Table 3).

Adjusted analysis also showed that Chinese participants were 2.0 (95% CI, 1.0 to 4.1, $P = 0.063$) times more likely to attend screening compared to Malay participants (Table 3). Women who had ever been screened were 2.1 (95% CI, 1.1 to 3.9, $P = 0.021$) times more likely to complete screening compared to women who had never been screened. Stratification of the effect of intervention on screening uptake by sociodemographic characteristics showed women in the tailored education-doctor's reminder-cost reduction arm who lived in public housing of 1 to 3 rooms were 3.0

Table 2. Demographic Characteristics of Study Participants at a Primary Care Facility in Singapore (May to August 2010), by Intervention Group

Variable		Tailored Education	Tailored Education with Doctor's Reminder	Tailored Education, Doctor's Reminder and Cost Reduction	All Participants
		n = 106 (%)	n = 181 (%)	n = 161 (%)	n = 448 (%)
Age group	40 – 49 years	31 (29.2)	44 (24.4)	50 (31.1)	125 (27.9)
	50 – 59 years	40 (37.7)	79 (43.6)	61 (37.9)	180 (40.2)
	60 – 69 years	35 (33.1)	58 (32.0)	50 (31.0)	143 (31.9)
Ethnicity	Chinese	52 (58.5)	116 (64.1)	123 (76.4)	301 (67.2)
	Malay	31 (29.2)	48 (26.5)	26 (16.1)	105 (23.4)
	Indian/others	13 (12.3)	17 (9.4)	12 (7.5)	42 (9.4)
Dwelling type	Public housing 1-/3-room flat	49 (46.2)	73 (40.3)	54 (33.5)	176 (39.3)
	Public housing 4-/5-room flat	50 (47.2)	90 (49.7)	81 (50.3)	221 (49.3)
	Private apartment or house	7 (6.6)	18 (10.0)	26 (16.2)	51 (11.4)
Education*	No formal	12 (11.3)	19 (10.5)	7 (4.3)	38 (8.5)
	Primary	36 (34.0)	62 (34.3)	53 (32.9)	151 (33.7)
	Secondary	45 (42.4)	72 (39.7)	64 (39.8)	181 (40.4)
	Tertiary	13 (12.3)	28 (15.5)	37 (23.0)	78 (17.4)
Employment status	Employed	45 (42.5)	67 (37.2)	69 (42.9)	181 (40.5)
	Not employed	51 (48.1)	94 (52.2)	71 (44.1)	216 (48.3)
	Retired	10 (9.4)	19 (10.6)	21 (13.0)	50 (11.2)
Screening history	Never been screened	35 (33.0)	72 (39.8)	46 (28.6)	153 (34.2)
	Ever been screened	71 (67.0)	109 (60.2)	115 (71.4)	295 (65.8)
Knowledge score	Low	43 (40.7)	75 (41.4)	68 (42.2)	186 (41.6)
	High	63 (59.3)	106 (58.6)	93 (57.8)	262 (58.4)
Attitude score	Low	69 (64.8)	99 (54.7)	84 (52.2)	252 (56.2)
	High	37 (35.2)	82 (45.3)	77 (47.8)	196 (43.8)
Belief score	Low	25 (24.1)	72 (39.8)	54 (33.5)	151 (33.8)
	High	81 (75.9)	109 (60.2)	107 (66.5)	297 (66.2)
Barriers score	Low	47 (44.4)	86 (48.0)	92 (57.1)	225 (50.4)
	High	59 (55.6)	93 (52.0)	69 (42.9)	221 (49.6)

*Highest education attained. Primary consists 6 years of education, secondary consists 10 to 11 years of education, and tertiary consists 12 or more years of education

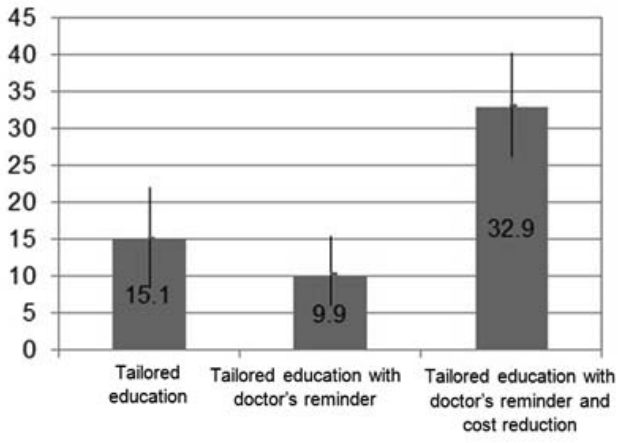

Fig 1. Mammogram attendance (%) at an urban primary care facility in Singapore (May to August 2010) across 3 intervention arms at completion of study (vertical bars indicate 95% confidence intervals).

Table 3. Odds Ratios (OR) and 95% Confidence Intervals (CI) for Mammogram Attendance in a Primary Care Facility in Singapore (May to August 2010) In Relation to Demographic and Other Predictors of Screening

		Crude OR (95% CI)	Adjusted* OR (95% CI)	*P* Value
Age	Per year increase	0.99 (0.96 – 1.03)	0.98 (0.95 – 1.02)	0.261
Ethnicity	Malay	1.0 (ref)	1.0 (ref)	-
	Chinese	2.7 (1.4 – 5.4)	2.0 (1.0 – 4.1)	0.063
	Indian/others	1.5 (0.5 – 4.3)	1.2 (0.4 – 3.6)	0.759
Dwelling type	Public housing 1-/3-room flat	1.0	1.0	-
	Public housing 4-/5-room flat	1.2 (0.7 – 1.9)	1.0 (0.6 – 1.8)	0.954
	Private apartment/house	1.7 (0.8 – 3.6)	1.0 (0.5 – 2.3)	0.956
Education†	No formal	1.0		
	Primary	1.1 (0.4 – 2.9)		
	Secondary	1.4 (0.6 – 3.7)		
	Tertiary	1.5 (0.5 – 4.2)		
Screening history	Never been screened	1.0	1.0	-
	Ever been screened	2.5 (1.4 – 4.4)	2.1 (1.1 – 3.9)	0.021
Knowledge score	Low	1.0		
	High	1.3 (0.8 – 2.1)		
Attitude score	Low	1.0	1.0	-
	High	1.7 (1.1 – 2.8)	1.6 (1.0 – 2.7)	0.053
Beliefs score	Low	1.0		
	High	1.0 (0.6 – 1.7)		
Barrier score	Low	1.0		
	High	0.9 (0.6 – 1.5)		
Intervention group	Tailored education	1.0	1.0	-
	Tailored education with doctor's reminder	0.6 (0.3 – 1.3)	0.6 (0.3 – 1.3)	0.212
	Tailored education with doctor's reminder and cost reduction	2.8 (1.5 – 5.3)	2.4 (1.2 – 4.5)	0.009

*Adjusted for age, ethnicity, dwelling type, prior screening and attitude towards screening. Further adjustment for education level did not affect the estimates. Knowledge, beliefs, and barrier score were not entered into model because $P > 0.05$.
†Highest education attained. Primary consists 6 years of education, secondary consists 10 to 11 years of education, and tertiary consists 12 or more years of education.

(95% CI, 1.1 to 8.4) times more likely to attend screening compared to women in the tailored education arm who shared a similar dwelling type (Table 4). The effect of tailored education-doctor's reminder-cost reduction was only significant amongst women with at least a secondary education (adjusted OR 3.2, 95% CI, 1.3 to 7.5) and not among those with few years of education (adjusted OR 1.7, 95% CI, 0.6 to 4.7).

Discussion

Cost reduction, as part of an intervention package, increased mammographic screening rates in this study population. This appeared to have a greater effect among women from a lower socioeconomic background,[18,19] but notably also varied with education level. Consistent with other findings, while cost may be an important factor deterring screening,[17,20] educational measures are also needed to address non-financial factors that may influence health-seeking behaviour.[21]

Chinese women were more likely than Indian and Malay women to attend screening. Given the observed discrepancy in uptake rates, culturally-relevant interventions are needed to bridge the persistent ethnic gap.[22,23] Women who have had a previous screening were more likely to return. Prior experience was likely to have helped develop trust and acceptability, thus encouraging further utilisation of

Table 4. Effect of Intervention on Screening Uptake in a Primary Care Facility in Singapore (May to August 2010), By Sociodemographic Characteristics

	Adjusted Odds Ratio (95% CI)	
Dwelling type	Public housing 1-/3-room flat (n = 176)	Public housing 4-/5-room flat and private property (n = 272)
Tailored education	1.0	1.0
Tailored education with doctor's reminder	0.5 (0.1 – 1.7)	0.8 (0.3 – 2.0)
Tailored education, doctor's reminder and cost reduction	3.0 (1.1 – 8.4)	2.3 (1.0 – 5.3)
Education	Below secondary (n = 189)	Secondary and above (n = 259)
Tailored education	1.0	1.0
Tailored education with doctor's reminder	0.5 (0.1 – 1.5)	0.9 (0.3 – 2.3)
Tailored education, doctor's reminder and cost reduction	1.7 (0.6 – 4.7)	3.2 (1.3 – 7.5)

services.[24] These women could also have been comparatively more proactive and aware of the tools of cancer prevention and early detection, and were therefore more responsive.

Non-attendees might be inhibited by a range of reasons. The lack of time, and "not having thought about it" were reasons previously cited.[25,26] The rationality of these responses may however obscure the underlying fatalistic attitude or fear of pain associated with the reluctance to screen, and the lack of acceptability of mammography as a screening modality.[21] The use of a personalised approach in this study aimed to address this specific challenge, particularly among women with low attitude and belief scores.

This study was designed as a quasi-randomised pragmatic trial. Experimental blinding was thus not implemented. Analysis was done on an intention-to-treat basis, and the risk of treatment effect dilution was small despite 2 instances of cross-over.

Doctors' reminders were not consistently delivered because participants did not always present their cues upon consultation. Whilst cost reduction appeared to result in a pronounced effect and could reasonably be hypothesised as singularly achieving an effect in the absence of a doctor's reminder, possible reasons for the blunted effectiveness of the doctor's reminder intervention, as compared to other studies,[27,28] may be the lack of time, or lack of standardisation, as reminders were not scripted. Future studies could address these factors, as observational studies suggest that the role of the doctor in promoting screening could be a positive one. The current study did not attempt to assess the effect of all possible predictors of screening, but focused on those most relevant to the intervention.

Participants screened beyond the study period were not captured. Although a standardised protocol was followed, patient navigators could have unconsciously varied their behaviour towards different individuals, leading to experimenter bias. Misclassification and recall bias could not be excluded as self-reported information was not verified. Interventions were designed as a package and isolated effects were not analysed. Nonetheless, the study, which was designed to model care under routine settings, benefits from a higher external validity.

Conclusion

The demonstrated effectiveness of the overall intervention strengthens the proposition for a longer-term, community-based cancer prevention and outreach initiative that includes patient navigation and cost reduction components. There is a need for larger, more generalisable studies to validate these results across multiple study sites. This would require building on collaborations with the network of polyclinics and diagnostics services, integrating patient navigation into existing workflow and record-keeping. Interface with the national screening programme, BreastScreen Singapore, would assist in the detection of under- and un-screened cases and the generation of cues for staff and clinicians at the primary care facility. Financing subsidy for mammograms for low income and medically underserved women would also be needed, as well as coordination with clinicians and the training of patient navigators.

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